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U S NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

REPORT NO 1146

PROJECTILES AND WARHEAD FRAGMENTATION

26th Partial Report

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TESTS OF FUZE BOOSTER ADEQUACY FOR SPARROW I WARHEADS

FINAL Report

Task Assignment NPG-Re2c-35-1-53

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Classification CONFIDENTIAL SECURITY INFORMATION

Tests of Fuze Booster Adequacy for Sparrow I Warheads

PART A

SYNOPSIS

1. This test was conducted to determine the adequacy of the Sparrow I fuze booster assembly and to obtain fragment velocities of the simulated warheads with undersized and oversized boosters.

2. a. The proposed 1"25 diameter by 2"00 long 70 gram tetryl fuze booster is considered adequate for producing a high order detonation in the Sparrow I warhead, which has 0"204 of metal between the tetryl fuze booster and the warhead filler.

b. The undersized and oversized tetryl fuze boosters produced similar fragment velocities in the simulated warheads, with results as follows:

Fuze Booster Size			Metal thickness between tetryl booster and warhead filler	Median Beam Spray Fragment Velocity
Length	Diam.	wt.(grams)		
1"25	1"25	44	0"204	5570 ft./sec.
2"50	1"25	88	0"142	5610 ft./sec.

Tests of Fuze Booster Adequacy for Sparrow I Warheads

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PART B

INTRODUCTION

1. AUTHORITY:

This test was authorized by reference (a) and conducted under Task Assignment No. NPG-Re2c-35-1-53, reference (b).

2. REFERENCES:

a. NOL Conf Work Request FA-80 of 22 April 1953
b. BUORD Conf ltr NP9 Re2c-JSM:rjb Ser 42665 of 29 July 1952

3. BACKGROUND:

The space for the tetryl fuze booster in the Sparrow I warhead is presently limited to a cylindrical volume, 1"25 diameter and 2"00 long. The fuze assembly also employs several metal sleeves of various thicknesses between the fuze tetryl and warhead explosive. The Naval Ordnance Laboratory requested the Naval Proving Ground, in reference (a), to conduct static tests to determine the adequacy of the present fuze assembly.

4. OBJECT OF TEST:

This test was conducted to determine the adequacy of the Sparrow I fuze booster assembly and to obtain fragment velocities of the simulated warheads with undersized and oversized boosters.

5. PERIOD OF TEST:

a.	Date Project Letters	22 April 1953
b.	Date Necessary Material Received	30 April 1953
c.	Date Commenced Test	12 May 1953
d.	Date Completed Test	18 May 1953

6. REPRESENTATIVE PRESENT:

This test was witnessed by Mr. G. F. Roberts, representing the Naval Ordnance Laboratory.

PART C

DETAILS OF TEST

7. DESCRIPTION OF ITEM UNDER TEST:

a. Undersized tetryl boosters 1".25 in diameter by 1".25 long, containing 44 grams of tetryl (the standard booster is 1".25 in diameter by 2".00 long, with 70 grams of tetryl). The boosters were each enclosed in an ".018 aluminum can, and surrounded by concentric sleeves ".042 steel, ".020 aluminum, ".062 steel, and ".062 steel warhead conduit, as shown in Figure 2. The total metal thickness between tetryl fuze booster and warhead filler was 0".204. This fuze arrangement was used in Rounds 2-6, inclusive.

b. Oversized tetryl boosters 1".25 in diameter by 2".50 long, containing 88 grams of tetryl. The five (5) boosters were enclosed as in (a) above except that one sleeve, ".062, was omitted, Figure 2. The total metal thickness between tetryl fuze booster and warhead filler was 0".142. This fuze arrangement was used in Rounds 1 and 7 to 10, inclusive.

c. Ten (10) simulated Sparrow I warheads, Figure 1, cylindrical, 6".15 outside diameter, 3/8" thick steel wall, 12".75 overall length, 0".50 thick end plates, and 1".75 inside diameter central conduit. For all rounds, the fuze was concentric with the conduit. These warheads were loaded with Composition B explosive at the Naval Ordnance Laboratory. The weights were as follows:

Rd. No.	Booster Size (inches) Diam.	Length	Distance of booster end from top of warhead (in.)	Warhead Weights (lbs.) Empty	Comp. B	Total
1	1-1/4	2-1/2	7/8	29.5	15.1	44.6
2	1-1/4	1-1/4	9/16	29.3	15.3	44.6
3	1-1/4	1-1/4	9/16	29.4	15.5	44.9
4	1-1/4	1-1/4	9/16	29.5	15.4	44.9
5	1-1/4	1-1/4	9/16	29.5	15.4	44.9
6	1-1/4	1-1/4	9/16	29.3	15.2	44.5
7	1-1/4	2-1/2	7/8	29.4	15.4	44.8
8	1-1/4	2-1/2	7/8	29.3	15.3	44.6
9	1-1/4	2-1/2	7/8	29.3	15.5	44.8
10	1-1/4	2-1/2	7/8	29.3	15.1	44.4

8. PROCEDURE:

The warheads were placed vertically with the top end up (front plate up) in the center of the 30' velocity arena on a 7-1/2 foot high stand. Each booster was initiated from the top of the warhead. The velocity arena plates at 30 feet are 1" thick STS and cover 1/3 of the total spherical area in polar zone 80°-105°. Fragment velocities were determined by the usual high speed photographic technique with a 16mm Fastax Camera.

9. RESULTS AND DISCUSSION:

a. The undersized (44 gram) tetryl booster was of sufficient size to detonate all five simulated warheads high order.

b. Increasing the booster size to 88 grams, and omitting one .062 thick steel conduit sleeve did not increase the fragment velocities of the simulated warheads. The detailed fragment velocities, listed in Table I, are summarized as follows:

No. Rds.	Booster Size Length	Diam.	wt.	Average Median Beam Spray Fragment Velocity (ft./sec.)
5	1.25	1.25	44 grams	5570
5	2.50	1.25	88 grams	5610

The difference, less than 1%, is within the accuracy of test.

PART D

CONCLUSIONS

10. a. The proposed 1"25 diameter by 2"00 long 70 gram tetryl fuze booster is considered adequate for producing a high order detonation in the Sparrow I warhead, which has 0"204 of metal between the tetryl fuze booster and the warhead filler.

b. The undersized and oversized tetryl fuze boosters produced similar fragment velocities in the simulated warheads, with results as follows:

Fuze Booster Size			Metal thickness between tetryl booster and warhead filler	Median Beam Spray Fragment Velocity
Length	Diam.	wt.(grams)		
1"25	1"25	44	0"204	5570 ft./sec.
2"50	1"25	88	0"142	5610 ft./sec.

Tests of Fuze Booster Adequacy for Sparrow I Warheads

- -

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NPG REPORT NO. 1146

U. S. NAVAL PROVING GROUND
DAHLGREN, VIRGINIA

Twenty-sixth Partial Report

on

Projectiles and Warhead Fragmentation

- -

Final Report

on

Tests of Fuze Booster Adequacy

for Sparrow I Warheads

Project No.: NPG-Re2c-35-1-53

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SECURITY INFORMATION

NP9 63398

12 May 1953

Simulated Sparrow I Warhead

Figure 1

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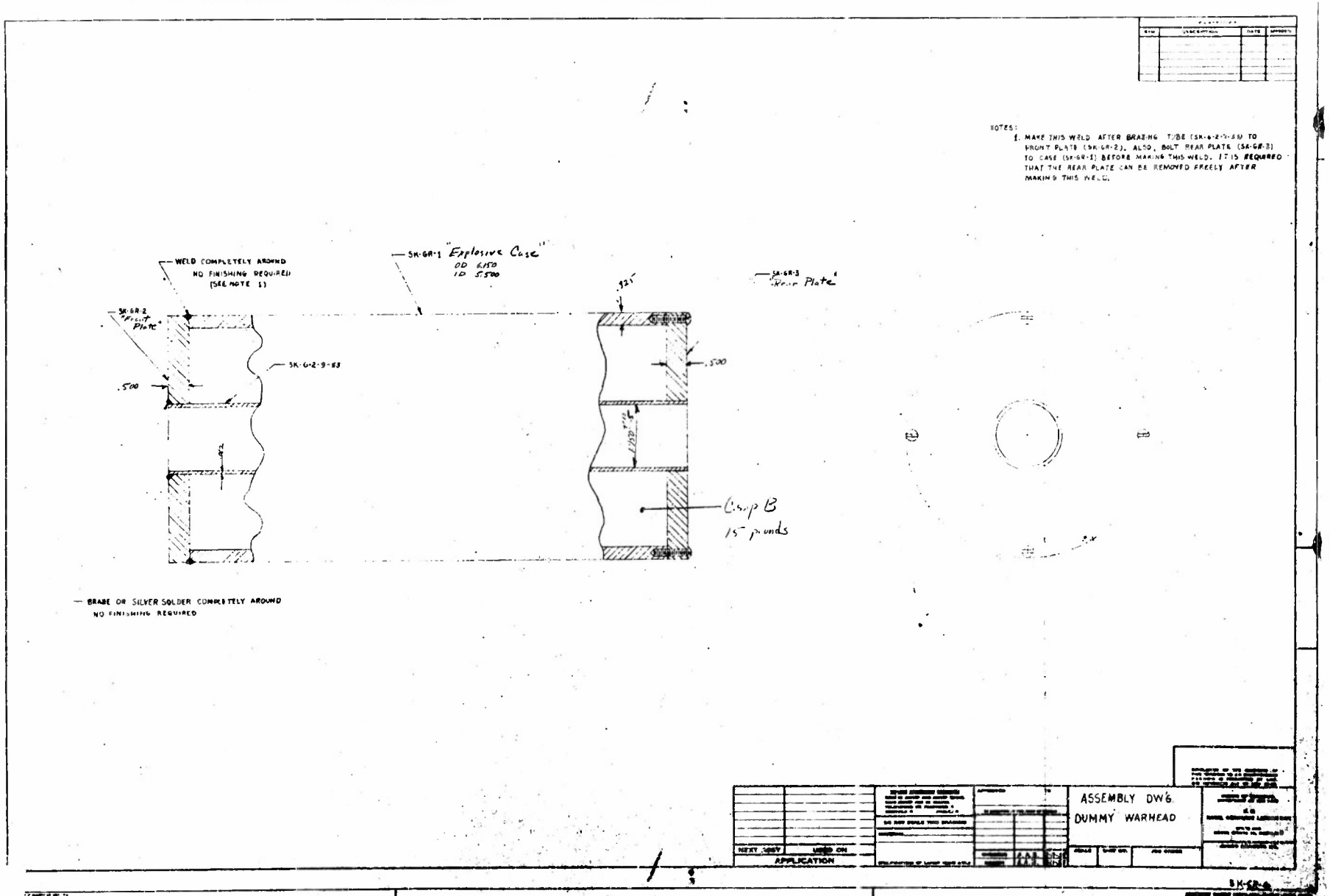

NP9-63399 12 May 1953.

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Order of Assembly for Sparrow Fuze Test: A - electric blasting cap, B - tetryl booster in .019 aluminum can, D - .042 steel sleeve, C - .020 aluminum sleeve, E - .062 steel sleeve, F - simulated Sparrow I warhead with .062 steel conduit. Sleeve E was omitted on Rounds 1, 7, 8, 9, and 10.

Figure 2

Tests of Fuze Booster Adequacy for Sparrow I Warheads

TABLE I

FRAGMENT VELOCITY DATA

30 Ft. Radius Velocity Arena

16mm Fastax Camera

Rd. 1, Simulated Sparrow Warhead I

Total Weight 44.6 lbs.

Date: 12 May 1953

5600 Frames per sec.

Filler Comp. B

Filler Weight 15.1 lbs.

Fuze Booster Size:
2-1/2" long x 1-1/4" diam.

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
28	9	6000
29	13	5790
30	10	5600
31	9	5420
32	7	5250
33	7	5090
34	2	4940
35	1	4800
36	3	4670
37	3	4540
39	1	4310
Median		5580
Average		5430

Tests of Fuze Booster Adequacy for Sparrow I Warheads

TABLE I (Continued)

30 Ft. Radius Velocity Arena — 5950 Frames per sec.

16mm Fastax Camera — Filler Comp. B

Rd. 2, Simulated Sparrow Warhead I — Filler Weight 15.3 lbs.

Total Weight 44.6 lbs. — Fuze Booster Size: 1-1/4" long x 1-1/4" diam.

Date: 12 May 1953

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
28	1	6380
29	6	6160
30	8	5950
31	14	5760
32	7	5580
33	5	5410
34	6	5250
35	8	5100
36	3	4960
37	2	4820
38	4	4700
39	2	4580
Median		5600
Average		5490

Tests of Fuze Booster Adequacy for Sparrow I Warheads

TABLE I (Continued)

30 Ft. Radius Velocity Arena — 5600 Frames per sec.

16mm Fastax Camera — Filler Comp. B

Rd. 3, Simulated Sparrow Warhead I — Filler Weight 15.5 lbs.

Total Weight 44.9 lbs. — Fuze Booster Size: 1-1/4" long x 1-1/4" diam.

Date: 12 May 1953

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
27	1	6220
28	10	6000
29	13	5790
30	9	5600
31	10	5420
32	5	5250
33	4	5090
34	5	4940
35	2	4800
36	3	4670
37	2	4540
38	1	4420
Median		5600
Average		5450

Tests of Fuze Booster Adequacy for Sparrow I Warheads

TABLE I (Continued)

30 Ft. Radius Velocity Arena — 5450 Frames per sec.

16mm Fastax Camera — Filler Comp. B

Rd. 4, Simulated Sparrow Warhead I — Filler Weight 15.4 lbs.

Total Weight 44.9 lbs. — Fuze Booster Size: 1-1/4" long x 1-1/4" diam.

Date: 12 May 1953

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
27	13	6060
28	11	5840
29	10	5640
30	8	5450
31	7	5270
32	5	5110
33	3	4950
34	5	4810
35	3	4670
36	2	4540
Median		5620
Average		5480

Tests of Fuze Booster Adequacy for Sparrow I Warheads

TABLE I (Continued)

30 Ft. Radius Velocity Arena — 5650 Frames per sec.

16mm Fastax Camera — Filler Comp. B

Rd. 5, Simulated Sparrow Warhead I — Filler Weight 15.4 lbs.

Total Weight 44.9 lbs. — Fuze Booster Size: 1-1/4" long x 1-1/4" diam.

Date: 12 May 1953

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
28	5	6050
29	15	5840
30	12	5650
31	6	5470
32	7	5300
33	6	5140
34	5	4990
35	7	4840
36	5	4710
38	1	4460
39	1	4350
Median		5550
Average		5390

Tests of Fuze Booster Adequacy for Sparrow I Warheads

TABLE I (Continued)

30 Ft. Radius Velocity Arena — 5700 Frames per sec.

16mm Fastax Camera — Filler Comp. B

Rd. 6, Simulated Sparrow Warhead I — Filler Weight 15.2 lbs.

Total Weight 44.5 lbs. — Fuze Booster Size: 1-1/4" long x 1-1/4" diam.

Date: 12 May 1953

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
28	2	6110
29	7	5900
30	13	5700
31	11	5520
32	6	5340
33	2	5180
34	5	5030
35	3	4890
36	5	4750
37	3	4620
38	1	4500
39	1	4380
40	1	4280
Median		5500
Average		5360

Tests of Fuze Booster Adequacy for Sparrow I Warheads

TABLE I (Continued)

30 Ft. Radius Velocity Arena — 5700 Frames per sec.

16mm Fastax Camera — Filler Comp. B

Rd. 6, Simulated Sparrow Warhead I — Filler Weight 15.2 lbs.

Total Weight 44.5 lbs. — Fuze Booster Size: 1-1/4" long x 1-1/4" diam.

Date: 12 May 1953

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
28	2	6110
29	7	5900
30	13	5700
31	11	5520
32	6	5340
33	2	5180
34	5	5030
35	3	4890
36	5	4750
37	3	4620
38	1	4500
39	1	4380
40	1	4280
Median		5500
Average		5360

Tests of Fuze Booster Adequacy for Sparrow I Warheads

TABLE I (Continued)

30 Ft. Radius Velocity Arena
16mm Fastax Camera
Rd. 7, Simulated Sparrow Warhead I
Total Weight 44.8 lbs.
Date: 12 May 1953

5550 Frames per sec.
Filler Comp. B
Filler Weight 15.4 lbs.
Fuze Booster Size:
2-1/2" long x 1-1/4" diam.

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
27	4	6170
28	15	5950
29	14	5740
30	7	5550
31	6	5370
32	4	5200
33	4	5050
34	3	4900
35	2	4760
36	1	4630
Median		5720
Average		5590

Tests of Fuze Booster Adequacy for Sparrow I Warheads

TABLE I (Continued)

30 Ft. Radius Velocity Arena — 5550 Frames per sec.

16mm Fastax Camera — Filler Comp. B

Rd. 8, Simulated Sparrow Warhead I — Filler Weight 15.3 lbs.

Total Weight 44.6 lbs. — Fuze Booster Size: 2-1/2" long x 1-1/4" diam.

Date: 12 May 1953

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
28	12	5950
29	18	5740
30	8	5550
31	7	5370
32	5	5200
33	3	5050
34	4	4900
35	4	4760
36	1	4630
37	2	4500
Median		5610
Average		5470

Tests of Fuze Booster Adequacy for Sparrow I Warheads

TABLE I (Continued)

30 Ft. Radius Velocity Arena — 5450 Frames per sec.

16mm Fastax Camera — Filler Comp. B

Rd. 9, Simulated Sparrow Warhead I — Filler Weight 15.5 lbs.

Total Weight 44.8 lbs. — Fuze Booster Size: 2-1/2" long x 1-1/4" diam.

Date: 12 May 1953

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
28	17	5840
29	15	5640
30	6	5450
31	7	5270
32	6	5110
33	2	4950
34	3	4810
35	1	4670
36	3	4540
38	1	4300
Median		5590
Average		5430

Tests of Fuze Booster Adequacy for Sparrow I Warheads

TABLE I (Continued)

30 Ft. Radius Velocity Arena — 5350 Frames per sec.

16mm Fastax Camera — Filler Comp. B

Rd. 10, Simulated Sparrow Warhead I — Filler Weight 15.1 lbs.

Total Weight 44.4 lbs. — Fuze Booster Size: 2-1/2" long x 1-1/4" diam.

Date: 12 May 1953

Frame in Which Hit Occurred	No. Fragments	Velocity (f/s)
26	2	6170
27	6	5940
28	18	5730
29	12	5530
30	7	5350
31	5	5180
32	2	5020
33	4	4860
34	4	4720
35	3	4590
36	1	4460
Median		5570
Average		5430